What Do We Know and What Don't We Know About The Effectiveness of Screening/Louvering and Handling Delta Smelt?

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Key Points – What We Know

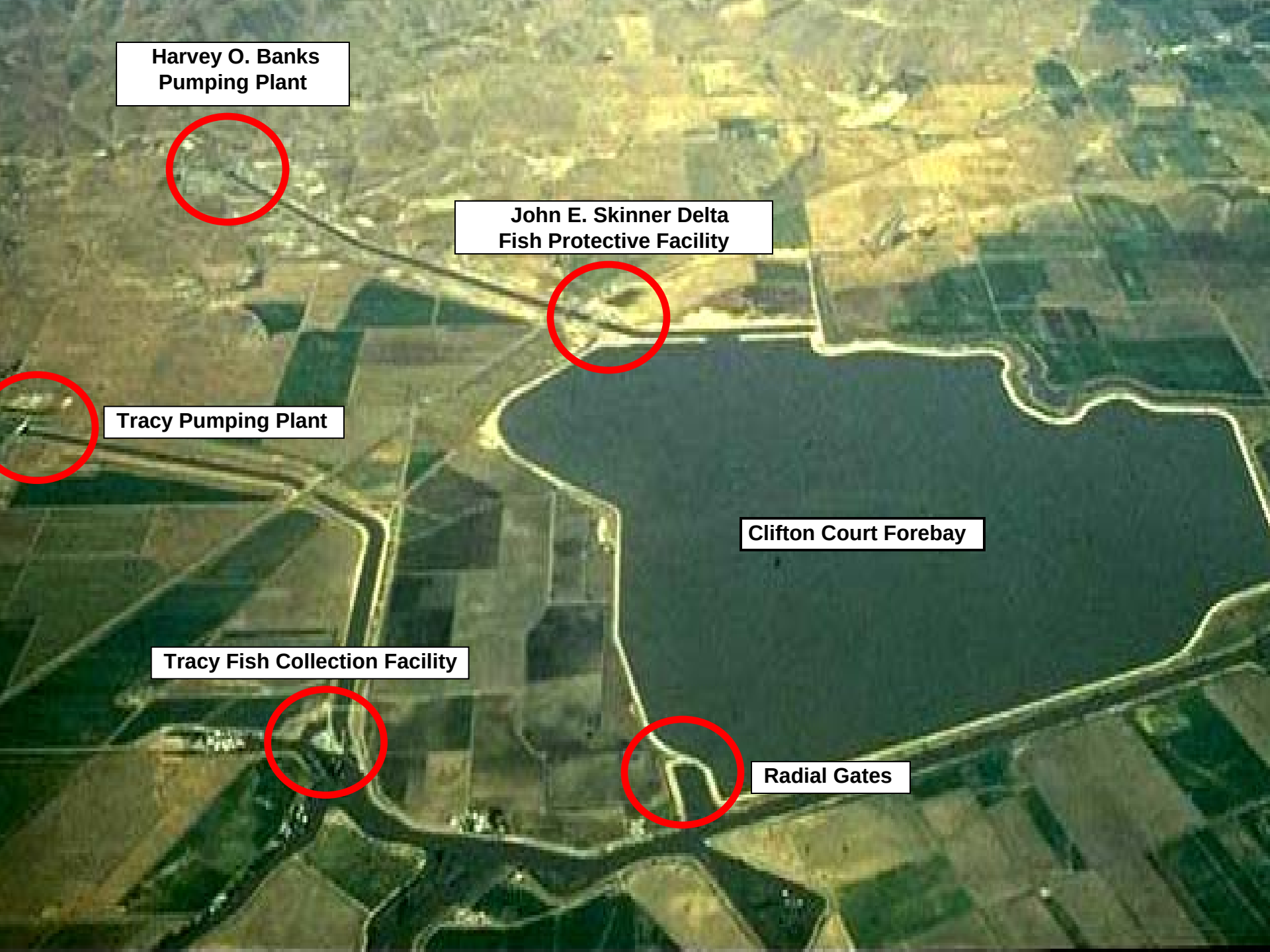
- We know that delta smelt to some degree survive the fish salvage operations at the TFCF and the SDFPF
- We know through established methods that delta smelt can be handled without causing injury or death
- We know that delta smelt can be successfully passed through specific types of pumps unharmed
- We know that delta smelt can now be successfully cultured

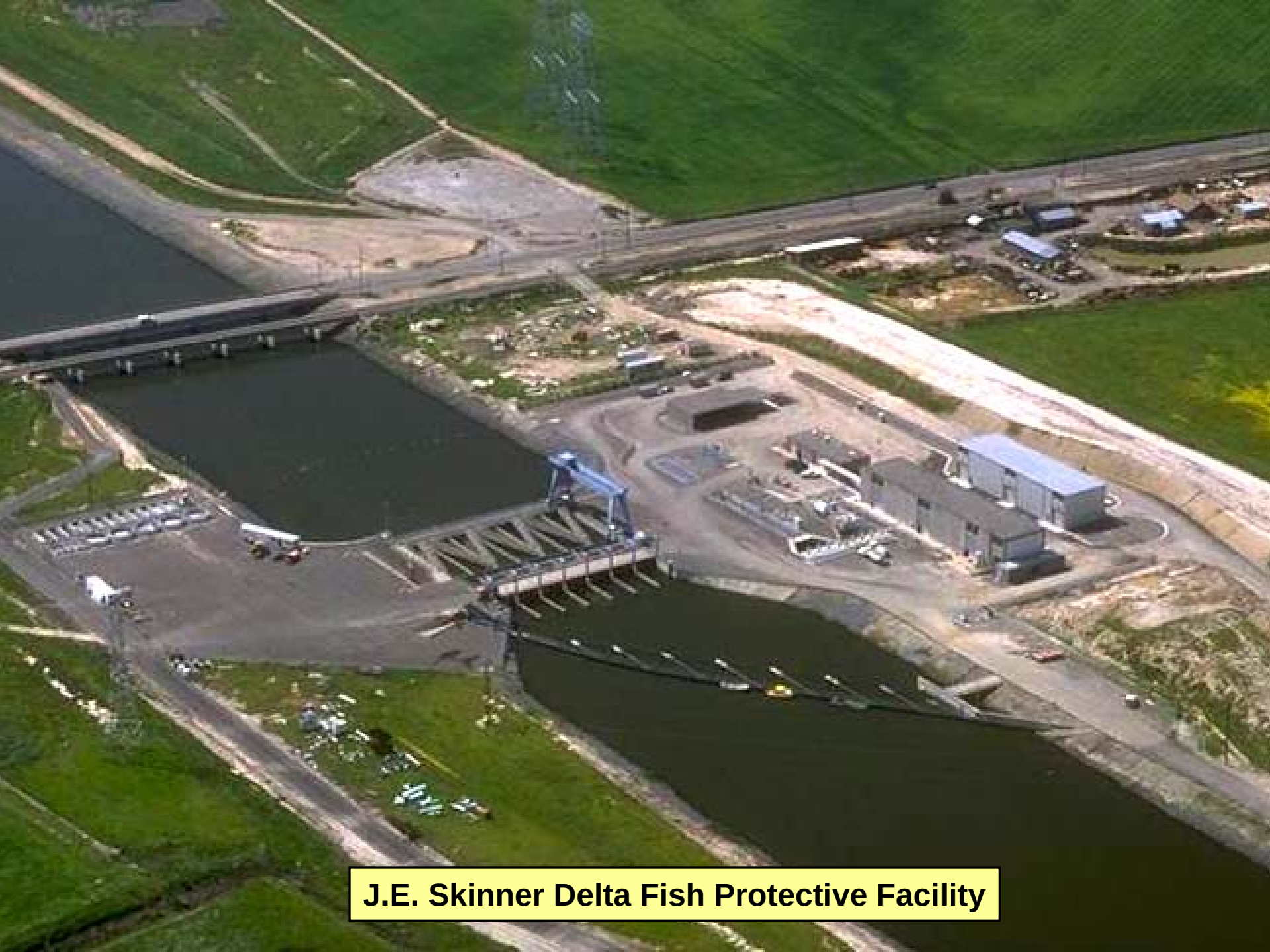
Key Points – What We Don't Know

- We don't know how much predation occurs on delta smelt within the fish salvage operations at the TFCF and the SDFPF

- We don't know what the efficiencies are for delta smelt for the primary louver systems at the TFCF and SDFPF

- We don't know the survival rates of delta smelt that are transported and released at the SWP and CVP fish release sites


Harvey O. Banks
Pumping Plant
John E. Skinner Delta
Fish Protective Facility
Tracy Pumping Plant
Clifton Court Forebay
Tracy Fish Collection Facility
Radial Gates


J.E. Skinner Delta Fish Protective Facility

How Do We Calculate Delta Smelt Losses ?

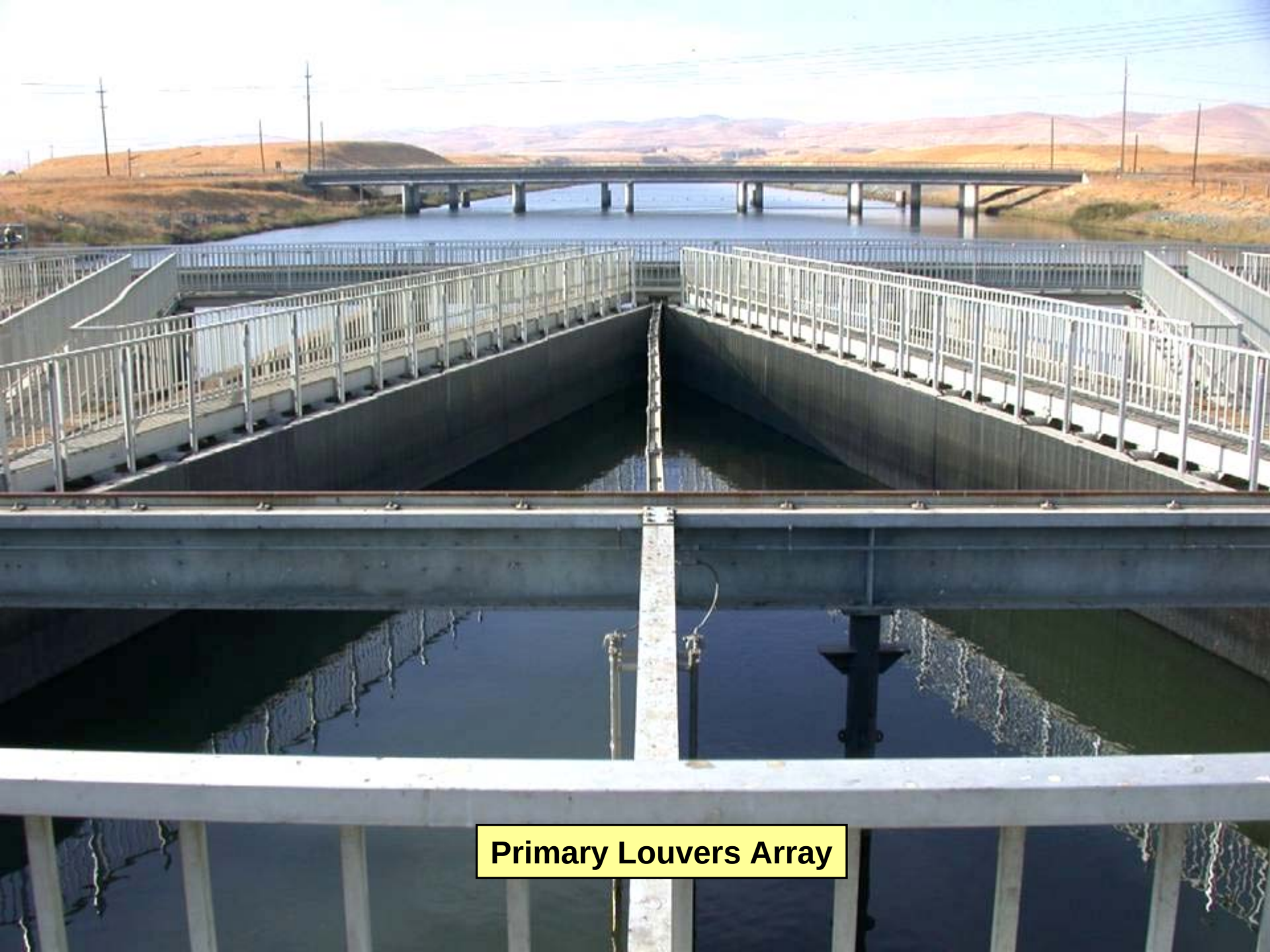
- Unlike for chinook salmon, we have no means of calculating loss for delta smelt at the TFCF and the SDFPF other than using expanded salvage

- No pre-screen loss experiments have been conducted at CCF using delta smelt

Can We Effectively Screen or Louver Delta Smelt?

SWP and CVP fish salvage facilities

- Existing facilities use louvers to guide fish instead of positive barrier fish screens


Primary Louvers Array

Can We Effectively Screen or Louver Delta Smelt?

- DFG and DWR louver evaluation studies at the SDFPF
    - Skinner *et al* 1970 - 1971

Results:

Fish Species	Primary Louver Efficiency
10 mm striped bass	< 1%
50 mm striped bass	50%
10 mm white catfish	1%
50 mm white catfish	> 45%

Can We Effectively Screen or Louver Delta Smelt?

- Fish treadmill experiments
    - Cech *et al* 1997 - 2002

- Multi agency effort
- Develop fish screen design and operational criteria for small Delta stream fishes

Can We Effectively Screen or Louver Delta Smelt?

- Fish treadmill experiments
    - Cech *et al* 1997 - 2002

Methods:

- Uses an annular flume incorporating an inner fixed screen and an outer rotating screen to test fish species
- Variety of fish species including delta smelt are tested under a range of approach and sweeping flow combinations.
- Fish are tested under day and night conditions
- Observe screen contact and impingement, survival and injury, behavior, handling and flow stress responses and combined effects

Can We Effectively Screen or Louver Delta Smelt?

- Secondary louver study using entrained wild delta smelt at the TFCF
  - Siegfried 1993 – 1995; Bowen 2002

Methods:

- Evaluations conducted from 1993 to 1995
- Compared results of fish salvage in the normal 10-minute counts with results of sieve-net sampling on the down stream end of the secondary channel during the 10-minute count
- Focus on wild entrained delta smelt

Can We Effectively Screen or Louver Delta Smelt?

- Secondary louver study using entrained wild delta smelt at the TFCF
  - Siegfried 1993 – 1995; Bowen 2002

Results:

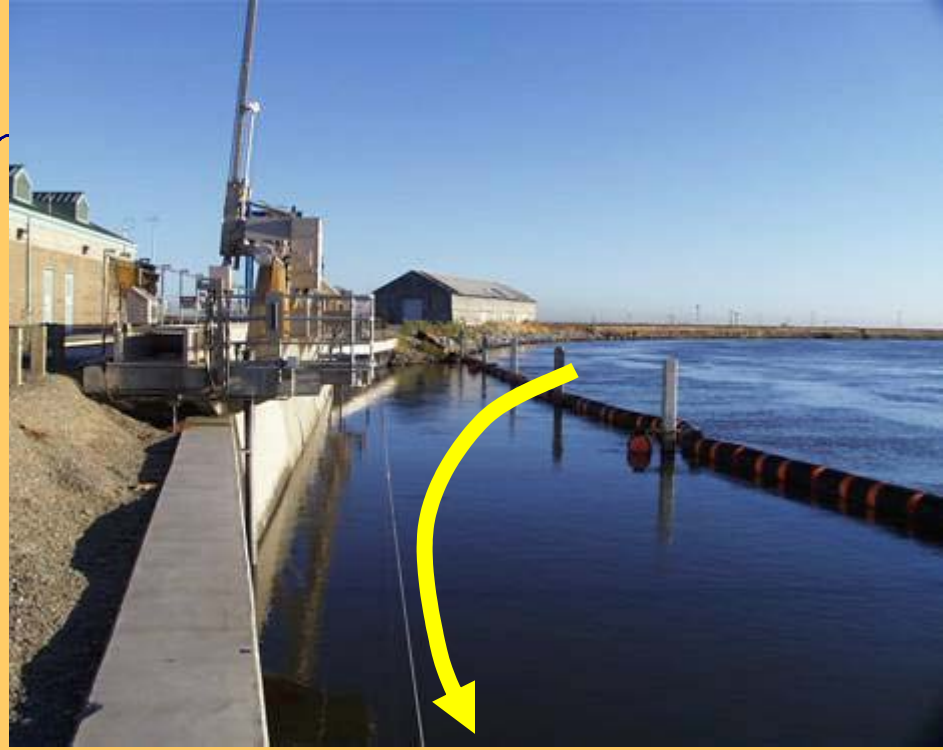
- Grand louver efficiency for delta smelt in the secondary channel at the TFCF = 65.0%

Can We Effectively Screen or Louver Delta Smelt?

Other screened facilities

- CCWD's Old River Pumping Plant

Consumnes River
Walnut Grove
Mokelumne River
Rio Vista
Montezuma Slough
Sacramento River
San Joaquin River
Pittsburg
Antioch
Stockton
Old River Fish Pumping Plant
Clifton Court Forebay
Tracy Fish Collection Facility
J.E. Skinner Delta Fish Protective Facility
N
W
E
S
10
20 Kilometers



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N
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Can We Handle Delta Smelt?

- Handling and trucking study at the SDFPF
    - Raquel 1984 – 1985

Methods:

- Evaluations conducted weekly (Sep 1984 – Oct 1985)
- Focused on chinook salmon, striped bass, American shad, steelhead, threadfin shad, and white catfish
- Fish were collected under normal operating conditions
- Control sample taken from 500 gallon loading bucket
- Trucked fish sample taken after simulated fish haul and release into a circular swimming pool
- Handled fish sample taken after releasing fish from the loading bucket into the swimming pool
- Observed immediate and 24-hour mortalities

Can We Handle Delta Smelt?

- Handling and trucking study at the SDFPF
  - Raquel 1984 – 1985

Results:

- Low catches of delta smelt (N=535 in 1985)
- Very few adult delta smelt salvaged (N=15)
- Higher survival rate for adult delta smelt (92% at 24-hour)
- More immediate juvenile delta smelt mortalities than after 24 hours

Survival Rate

	Overall*	Juveniles
Control	34% (24-h)	31% (24-h)
Handled	24%	17%
Trucked	12%	11%

*Overall survival rate includes both adults and juveniles

Can We Handle Delta Smelt?

- Use of salts, anesthetics and polymers to minimize handling and transport mortalities in Delta Smelt
    - Swanson *et al* 1993

Methods:

- Delta smelt were collected in the Sacramento-San Joaquin estuary from August to November 1993
- Polyethylene plastic bags were used to replace the mesh on hand dip nets to minimize handling
- Delta smelt were transported in different transport containers
- Used combinations of salt concentrations, anesthetics, and a commercial water conditioner

Can We Handle Delta Smelt?

- Handling and trucking pilot study at the SDFPF
  - Morinaka 1995

Methods:

- Total of 5 trucking experiments and 1 handling experiments using delta smelt adults (Jan 1995 – Mar 1995)
- Fish were collected under normal operating conditions
- Control sample taken from 500 gallon loading bucket
- Trucked fish sample taken after simulated fish haul directly from the truck tank and after release into a circular swimming pool
- Handled fish sample taken after releasing fish from the loading bucket into the truck tank
- Observed immediate, 24-hour, 48-hour, and 172-hour mortalities

Can We Handle Delta Smelt?

- Handling and trucking pilot study at the SDFPF
  - Morinaka 1995

Results:

- Survival rate for the 5 trucking experiments ranged from 73% to 100%
- The control group in the first trucking experiment had no survival after 48 hours. Control fish held with other salvaged fish.
- Control and test fish for remainder of experiments held by themselves, without other salvaged fish.

Survival Rate

	Control	Test
1.Trucked (3ppt salt)	0%	94%
2.Trucked (3ppt salt)	100%	91%
3.Trucked (3ppt salt)	96%	94%
4.Trucked(R) (3ppt salt)	100%	73%
5.Trucked (8ppt salt)	93%	100%
6.Handled	100%	97%

Can We Handle Delta Smelt?

- Assessment of survival and condition of fish passed through a Hidrostal pump at the USBR, TFCF
    - Helfrich *et al* 1998 - 1999

Methods:

- Sets of experimental trials conducted between December 1998 and July 1999
- Juvenile splittail and juvenile fall-run chinook salmon used for pumping experiments
- Test fish were passed through a 41-cm diameter Hidrostal (internal helical, centrifugal) pump
- Groups of treatment fish inserted immediately upstream of the pump and groups of control fish were inserted downstream of the pump
- Entrained fish were conveyed through a smooth pipe and discharged into a large rectangular pool

Can We Handle Delta Smelt?

- Assessment of survival and condition of fish passed through a Hidrostal pump at the USBR, TFCF
    - Helfrich *et al* 1998 - 1999

Results:

- Other fish species entrained incidentally during the trials
- 15 fertile delta smelt passed through the pump alive and in good condition
- 543 post-larvae delta smelt passed through the pump with only one mortality.

Can We Handle Delta Smelt?

- Handling and trucking study at the JESDFPF
    - Edwards 1999; McGee 2000

1999 Methods:

- Evaluations conducted weekly (Spring 1999)
- Emphasis on delta smelt and splittail
- Methodology similar to Raquel's study in 1984-1985
- Control and test fish held for 48 hours.
- Salt was added to the truck tanks at 3ppt and 8ppt
- Delta smelt were handled using the water to water method

Can We Handle Delta Smelt?

- Handling and trucking study at the JESDFPF
  - Edwards 1999; McGee 2000

1999 Results:

- Very few adult delta smelt tested (N=10) in February and April

Survival Rate (Pooled percent survival)

	Control	Test
Handled	20.5%	19.4%
Trucked	23.3%	48.3%
Trucked (3ppt salt)	23.2%	55.6%
Trucked (8ppt salt)	23.2%	28.9%

Can We Handle Delta Smelt?

- Handling and trucking study at the JESDFPF
    - Edwards 1999; McGee 2000

Results:

- Very few delta smelt overall were observed in the trials (N=525)

Survival Rate (Pooled percent survival)

	Control	Test
Handled	1.2%	6.2%
Trucked	2.6%	0.0%

Can We Handle Delta Smelt?

- Assessment of survival and condition of laboratory reared adult delta smelt passed through a Hidrostal pump at the USBR, TFCF
    - Helfrich 2001

Methods:

- Known numbers of laboratory reared delta smelt used in the trials (62-71 mm mean FL)
- Test fish were passed through a 41-cm diameter Hidrostal (internal helical, centrifugal) pump
- Groups of treatment fish inserted immediately upstream of the pump and groups of control fish were inserted downstream of the pump
- Test and control groups held for 96 hours (post trial)

Can We Handle Delta Smelt?

- Assessment of survival and condition of laboratory reared adult delta smelt passed through a Hidrostal pump at the USBR, TFCF
    - Helfrich 2001

Results:

Survival Rate

	Control	Test
October	100%	85.7%
November	91%	84.3%

Can We Handle Delta Smelt?

- UCD Delta Smelt Culture
  - Baskerville-Bridges *et al* 1998 to present

Can We Handle Delta Smelt?

- UCD Delta Smelt Culture
  - Baskerville-Bridges *et al* 1998 to present

- Successful culture from egg to juvenile was first achieved during the 1998-1999 season
- Established that delta smelt larvae require suspended particles in the rearing water to initiate feeding
- Source for experimental test fish

Conclusions

- We know that delta smelt can survive the fish salvage process at the South Delta Fish Salvage Facilities
- The handling and trucking studies at the SDFPF were conducted under varying conditions and used some different methodologies. Results vary and significant losses occur during some sections of the salvage process, therefore addition studies are warranted
- We have developed methods and continue to learn new methods to properly handle and transport delta smelt
- We now have a fish culture facility that can raise, hold, and supply various life stages of delta smelt for experiments

Conclusions (cont'd)

- We know that delta smelt can successfully be passed through specific types of pumps
- We continue to lack information that can demonstrate the magnitude of predation on delta smelt at the SWP and CVP fish salvage facilities and fish release sites
- Aside from the secondary louver efficiency studies conducted at the TFCF, there remains a lot that we do not know about the primary and secondary louver efficiencies at the TFCF and the SDFPF

Acknowledgements

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